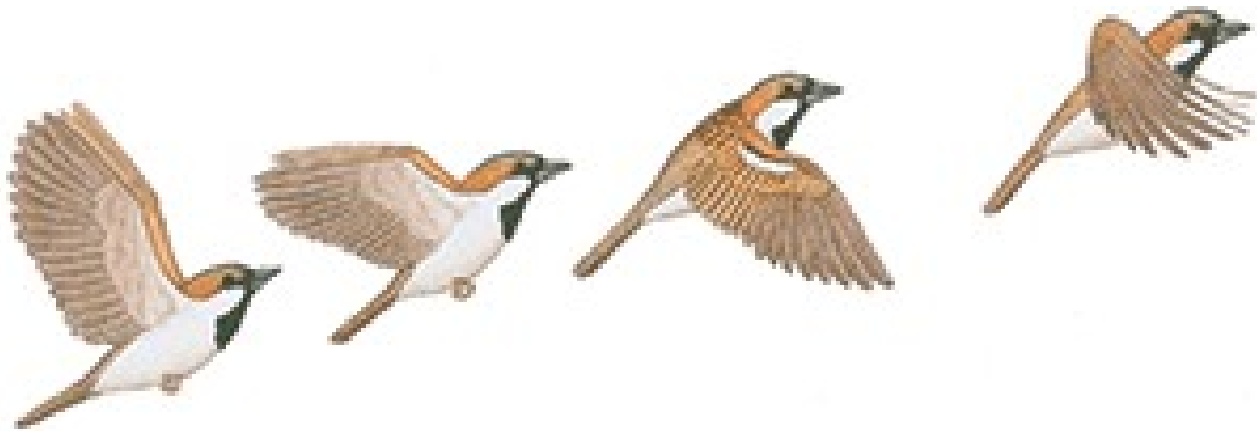
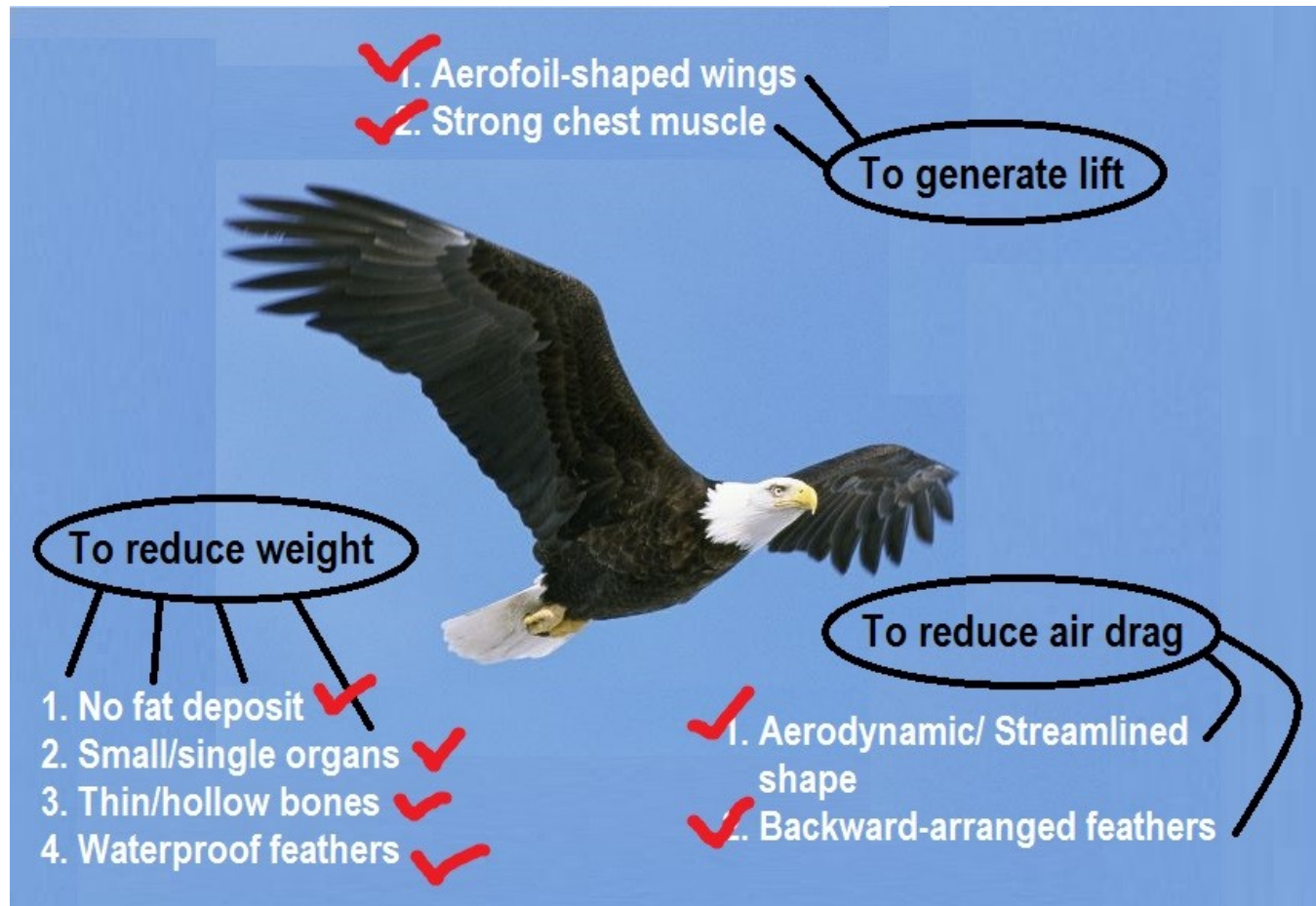


# FLIGHT ADAPTATIONS IN BIRDS





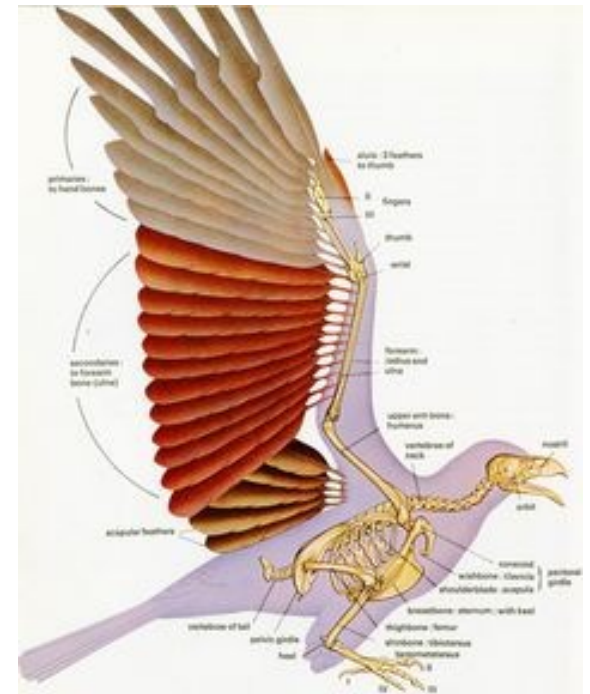
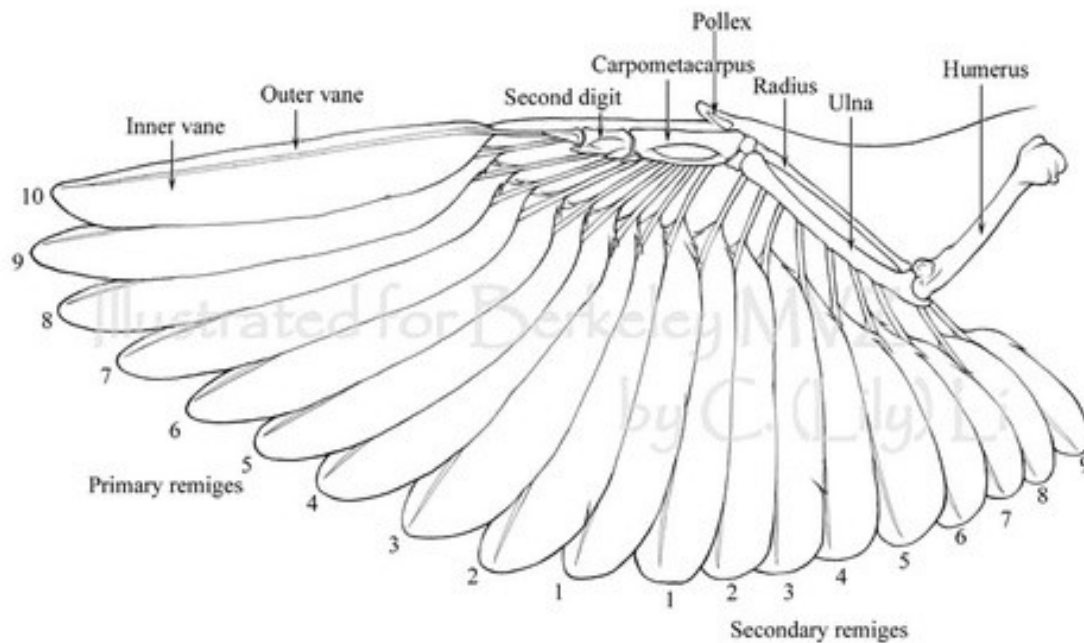
## **Body Shape**

- **Birds have short, light and compact body as compared to other animals.**
- **Most organs and large muscles are located near the center of gravity, which is slightly below and behind the wings to provide better balance during flight.**

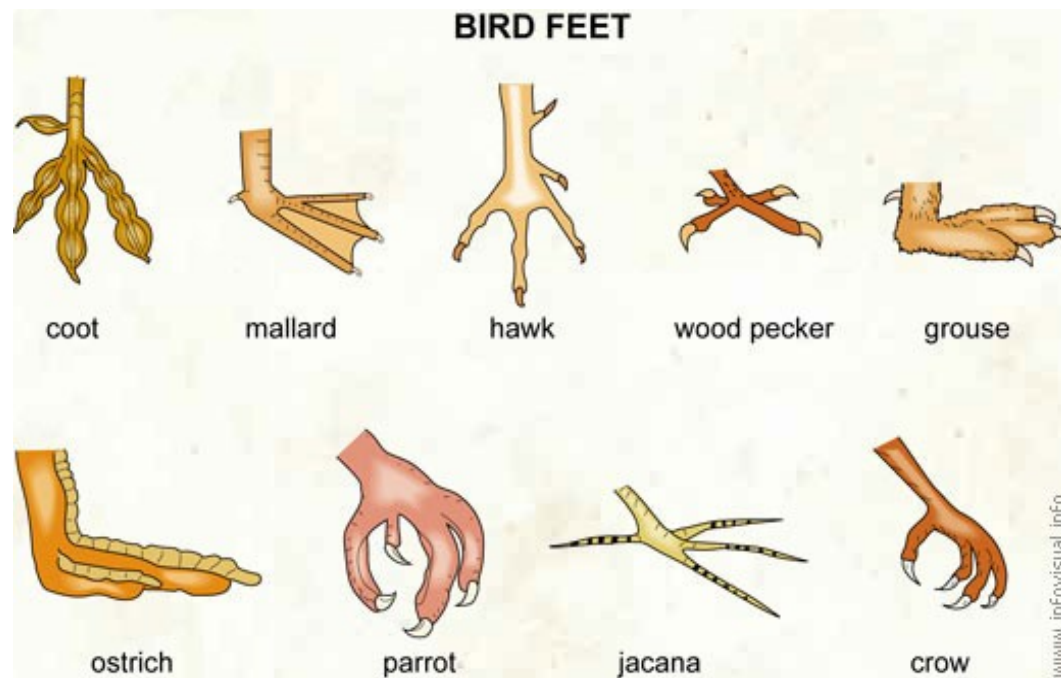
## MORPHOLOGICAL ADAPTATION

- **Shape and structure of the body :**  
**Boat shaped streamlined avian body facilitates bird's passage through air offering minimum resistance**
- **Neck and beak :** Neck is long and flexible ,so the bird can easily rotate its head for reaching its food and can see all around. The two jaws produced into a beak is suitable for picking food, preening, nest building

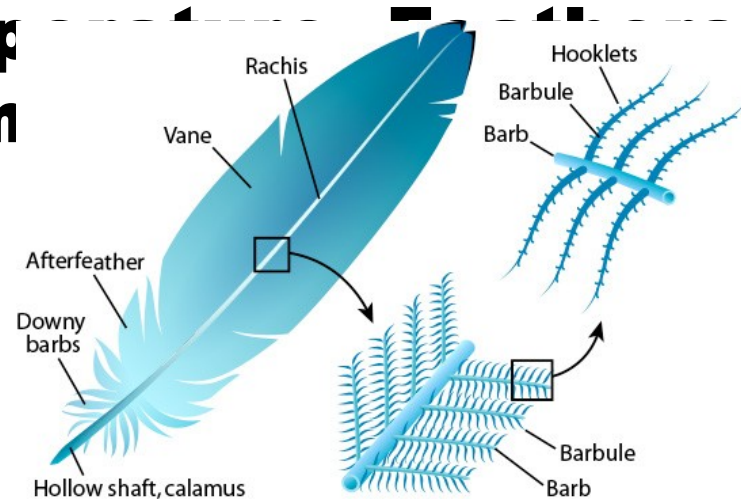
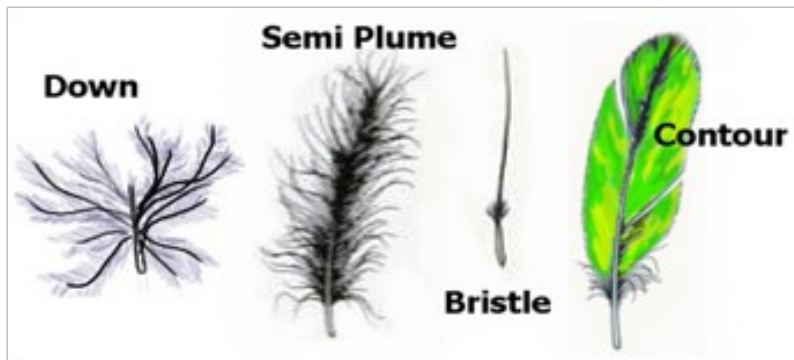
- **FORE LIMBS :** modified into wings act as propelling organ for flight. They are provided with flight feathers (remiges), forming a fairly rigid but sufficiently flexible plane and are flapped with the aid of powerful pectoral muscles



- **Hind limbs** : acts as locomotory organs(bipedal locomotion ).They are shifted forwards for balancing and supporting the entire body weight. They are covered by scales ,digits end in claws. They are also modified for perching in response to arboreal life. Feet of birds are variously modified based on their habit and habitat.



- **Exo skeleton :** Feathers are characteristic structures of birds. Feathers of various types cover the entire body surface making it smooth and streamlined. The non-conducting coat of feathers prevent surface loss of heat and helps in maintaining constant body temperature.



- **Tail :** is short and bear long tail feathers or rectrices which are arranged in a fan-like manner. The tail feathers act as a rudder for steering and balancing.



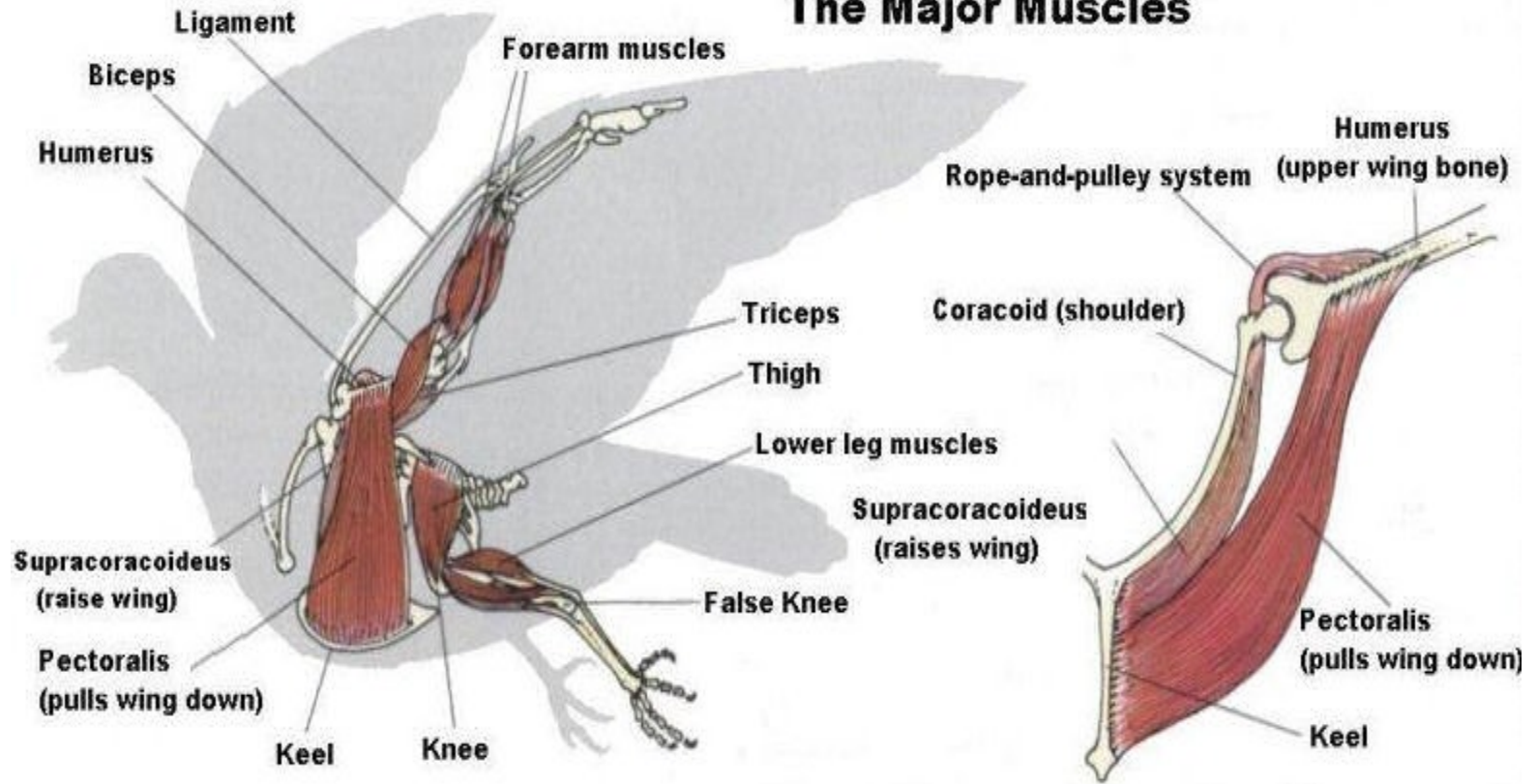


# Anatomical Adaptations

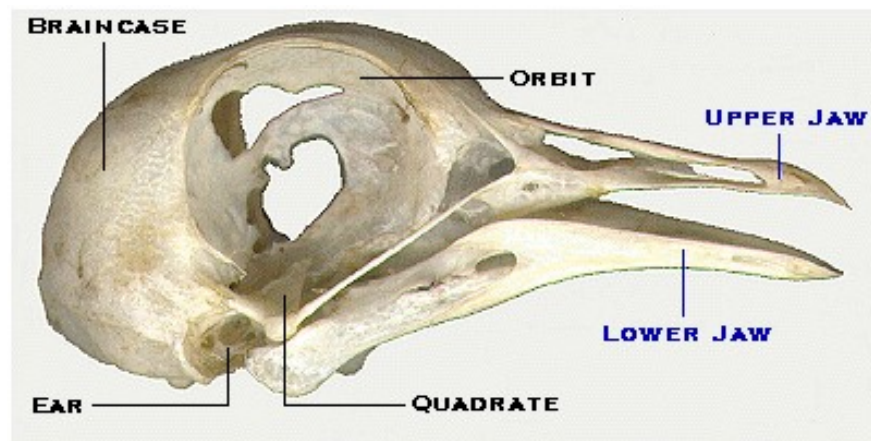
- **Flight Muscles :** While the muscles on the back are highly reduced, the flight muscles on the breast are well developed for effective movement of the wings.

The largest muscle **pectoralis major** is the depressor muscle for down-ward stroke of wings, **pectoralis minor** is the elevator muscles which raises the wings, **coraco-brachialis** and **coraco-humeralis** rotates the wings , **tensor muscle** stretches the wings

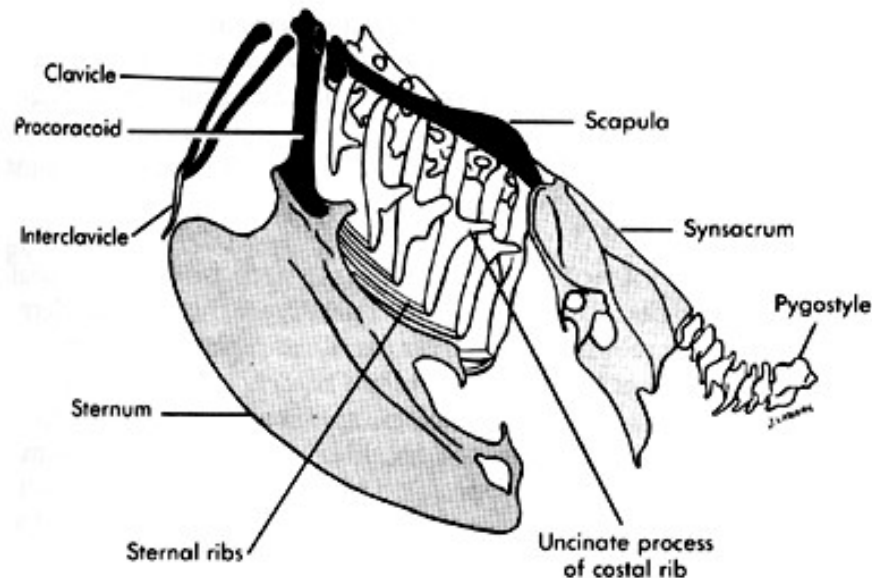
## The Major Muscles



- **Endoskeleton** : Modifications are such that the endoskeleton has become light ,yet maintains rigidity and strength. There is pneumatization (hollow) of bones along with reduction and fusion of bones
- \* **Skull** : Most of the bones of the skull are fused without any suture .Jaws are produced into beak .teeth absent to reduce weight, many bones are slender

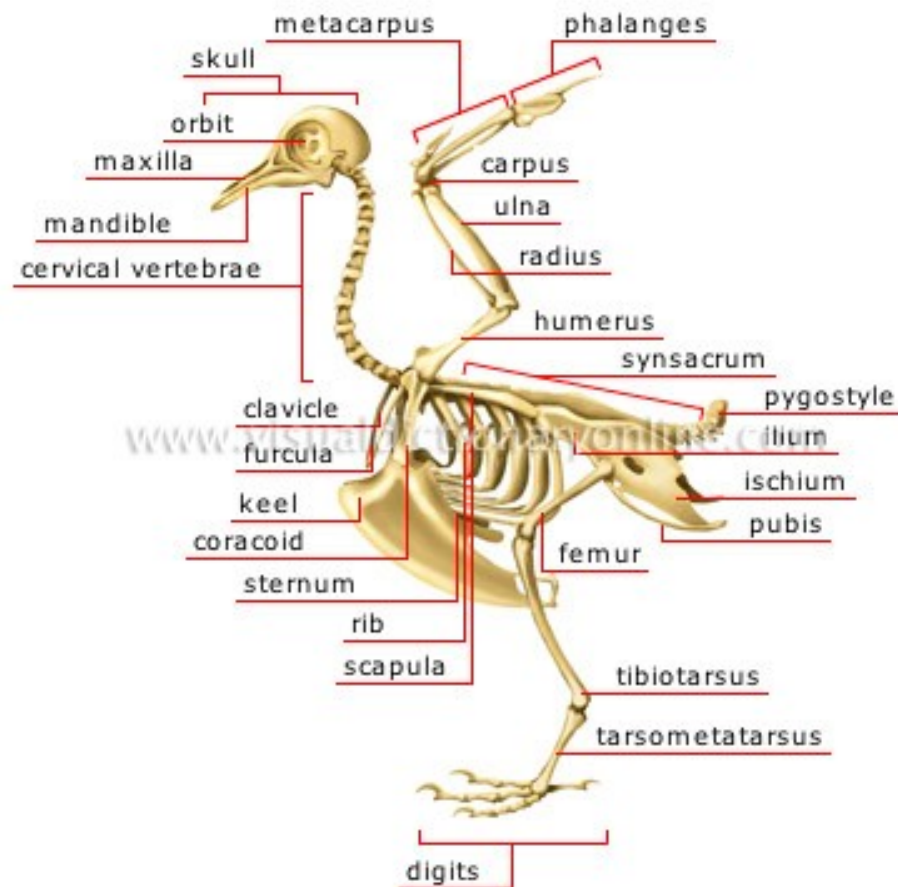


- A **keel** or **carina** is an extension of the **sternum** (breastbone) which runs axially along the midline of the sternum and extends outward, perpendicular to the plane of the **ribs**. The keel provides an anchor to which a bird's wing muscles attach, thereby providing adequate leverage for flight.



- **Vertebral column :** The first 4-5 thoracic vertebrae fuse to form a strong **fulcrum** against which the wings work . A complex **Synsacrum** is formed by fusion of the last thoracic vertebra, all lumbar and sacra and some anterior caudal vertebrae. The ilia of pelvic girdle are fused to it for balancing the body. The posterior few caudal vertebrae fuse to form a short **pygostyle** to which the tail feathers (rectrices) are attached

# Skeleton of bird



- **Sternum** : has a **keel** or **carina** for attachment of flight muscles. The backward elongation of the sternum supports the abdominal viscera
- **Girdles** : the stout coracoid is attached anteriorly to the scapula and posteriorly to the sternum. The scapula is also attached to the ribs. The pelvis and synsacrum are fused to support the body weight and to counteract the shock when the bird alights on the ground

- **Limbs :** The fore limbs and hind limbs are suitably adapted for flight and exhibit fusion and reduction of bones. The carpals and metacarpals are fused to form carpo-metacarpals. The constituent bones of the forelimbs are light and strong to bear the weight of muscles during flight

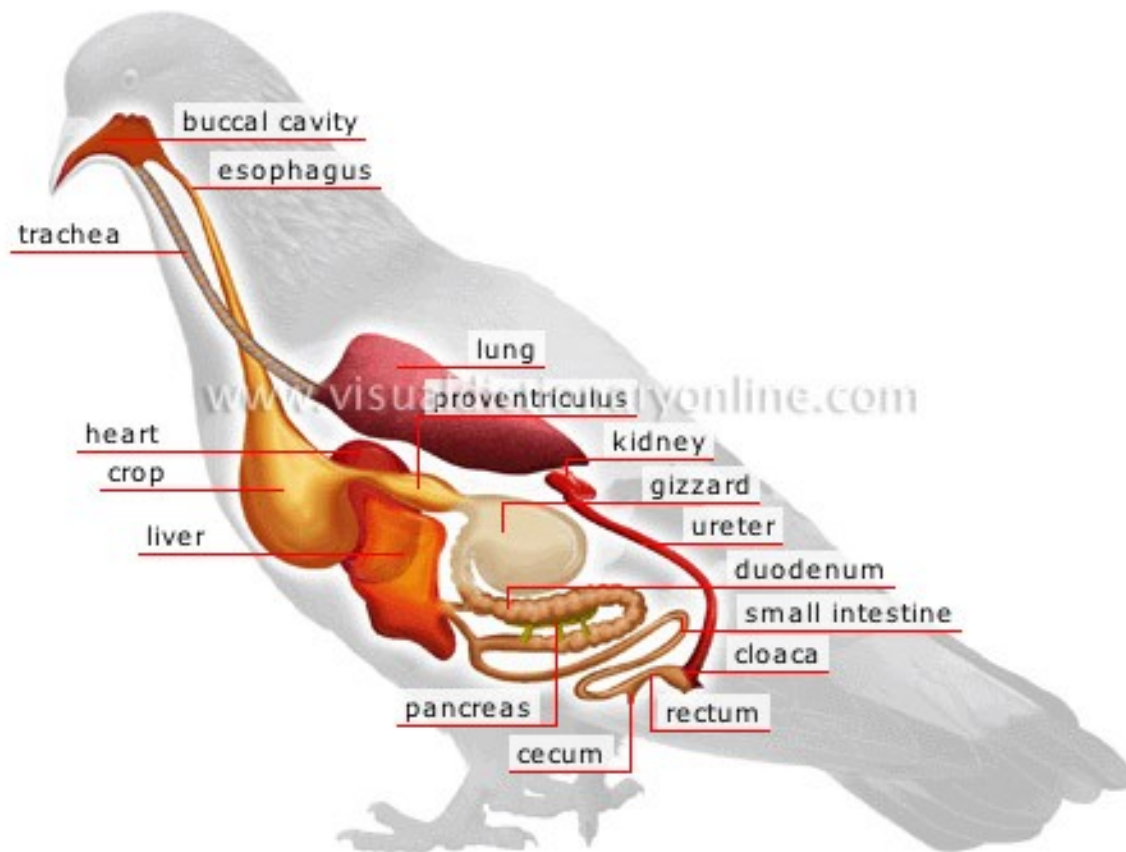
**In the hind limbs the fibula is reduced. Lower end of tibia is fused with the proximal row of tarsals to form tibio-tarsus**



# **Digestive system**

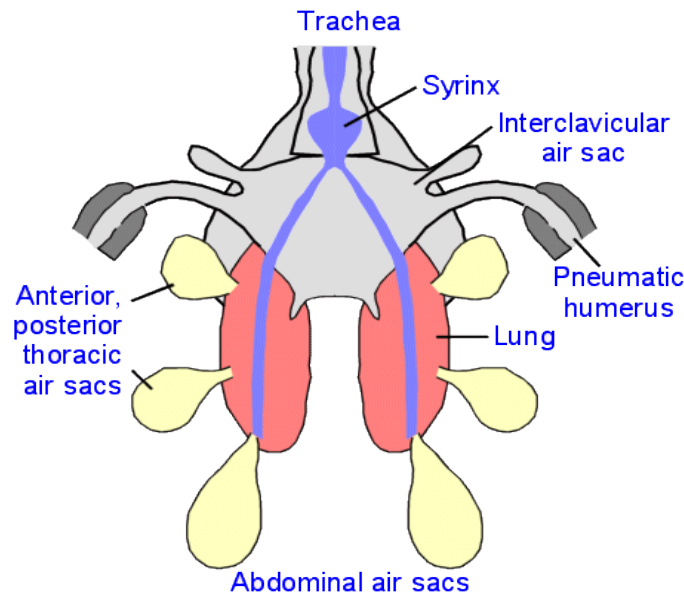
**The metabolic rate is high in birds due to which they consume more food. The food is digested rapidly with minimum of undigested matter , which is eliminated immediately, therefore rectum is short The sac-like crop serves to store the food, the muscular gizzard grinds the food.**

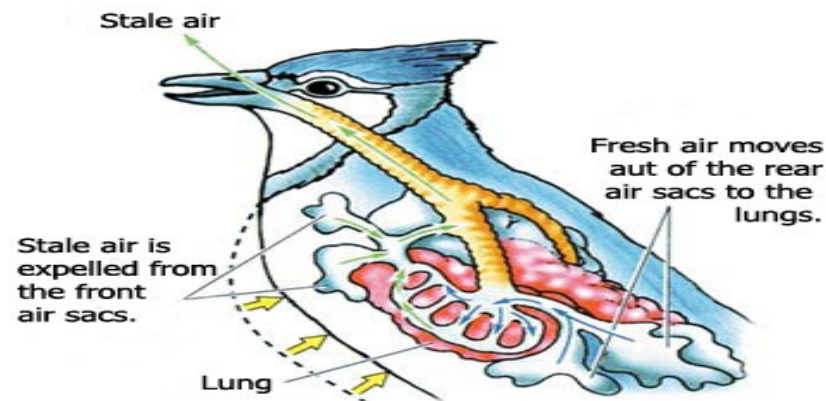
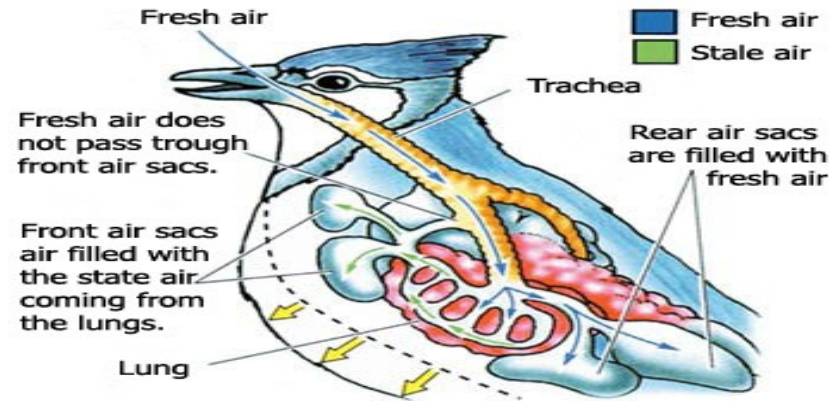
# Anatomy of bird



# Respiratory system

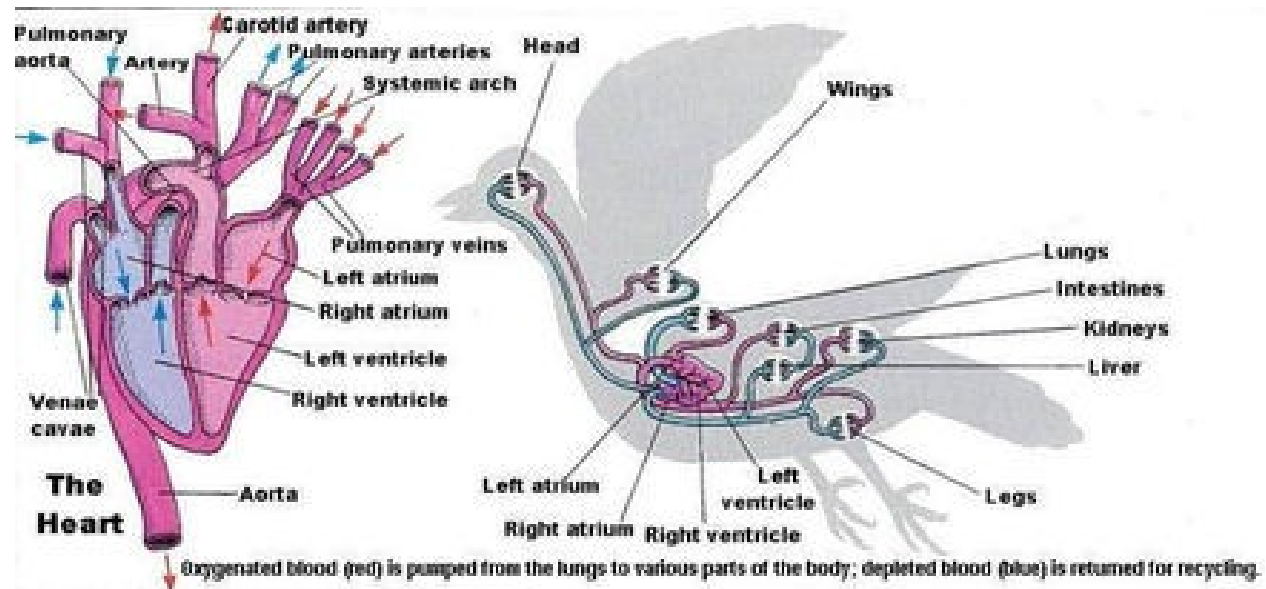
**Though lungs are small ,the inter-communicating system of para-bronchi provides large respiratory surface for gaseous exchange There is no dead space in the lungs .Respiration is efficient and complete .A network of air sacs helps to store oxygen when flying,especially at high altitude.**





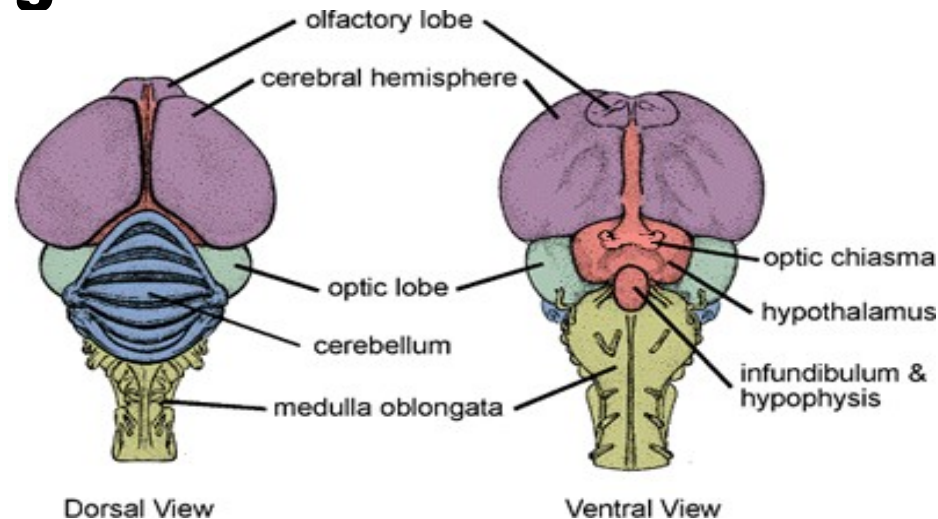
# Circulatory System

**Heart is completely four chambered double circulation is seen The blood contains more RBCs with high haemoglobin content for rapid and efficient oxygenation providing more energy**



# Brain

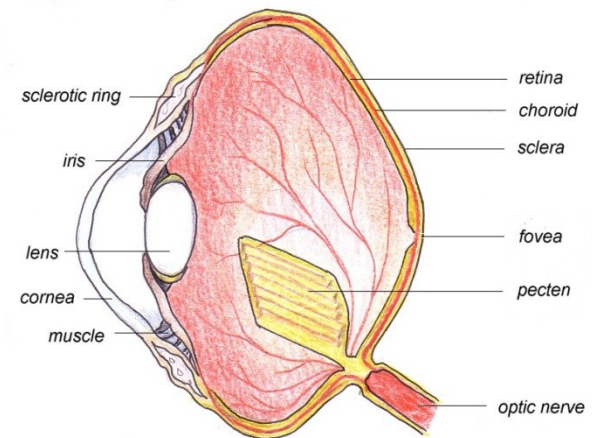
**Brain have acute sense of sight and so the optic lobes are well developed .The cerebellum is large and convoluted for control and regulation of muscular co-ordination and equilibrium.The olfactory lobes are small due to poor sense of smelling**



## Sense organs

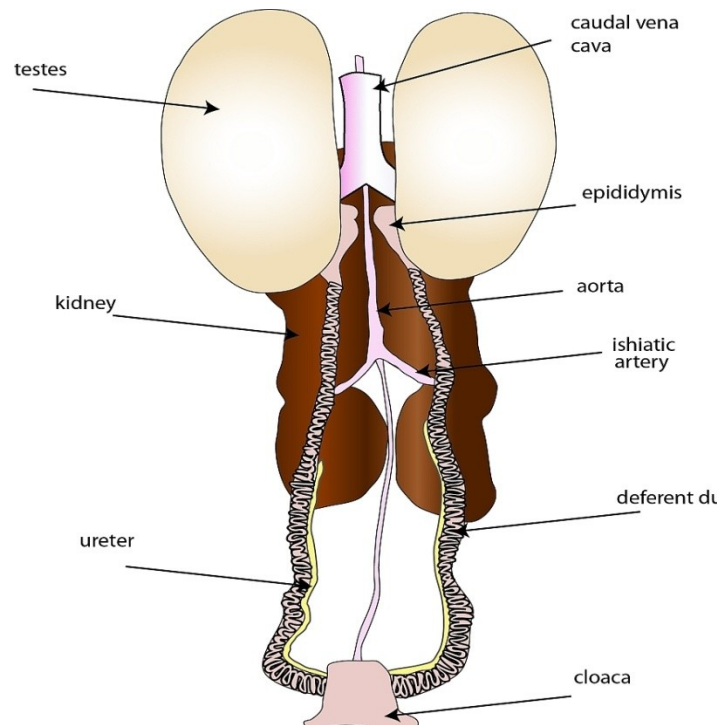
The sense of sight being acute, the eyes in bird are very large in relation to head. There is an outer ring of sclerotic plates for resisting the air pressure during flight.

**Pecten** a comb shaped structure in the eye helps in lubrication of eye and in detection of minute movements at great distance



# Urinary system

**Urinary bladder is absent to reduce weight. As a measure of water conservation water is absorbed by the urinary tubules and cloaca. The semi-solid nitrogenous waste is eliminated immediately.**

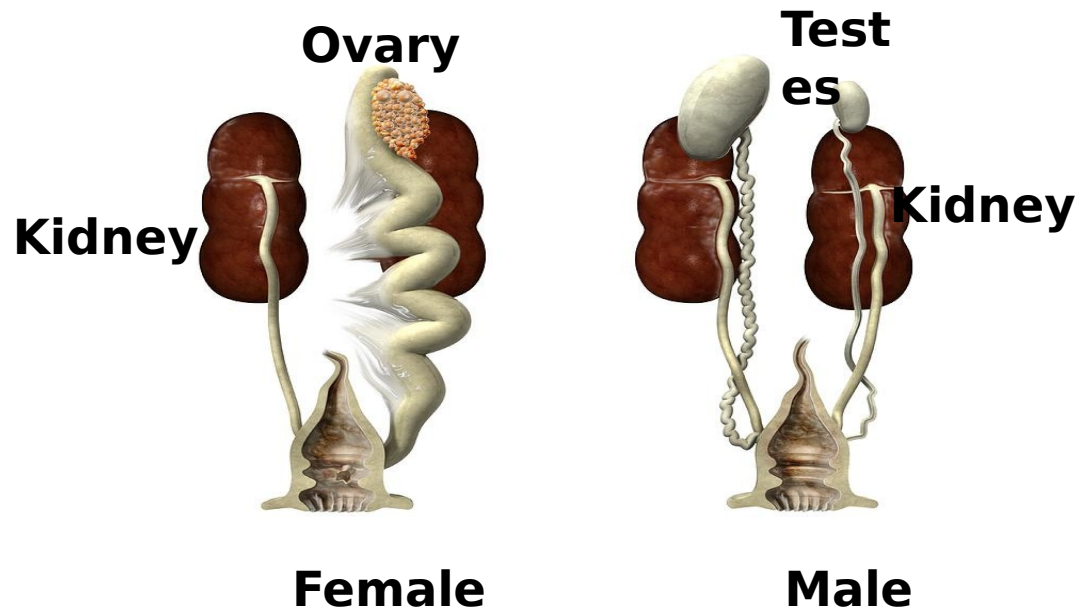




# Genital system

**The avian female begins life with two ovaries and oviducts. However, in most species of birds, the left ovary and oviduct grow more rapidly than the right, and the right side regresses, leaving only the left ovary and oviduct. This is an adaptation to reduce weight, necessary to aid flight.**

**In males both the testes are retained**



**Credits :**  
**Wikipedia**